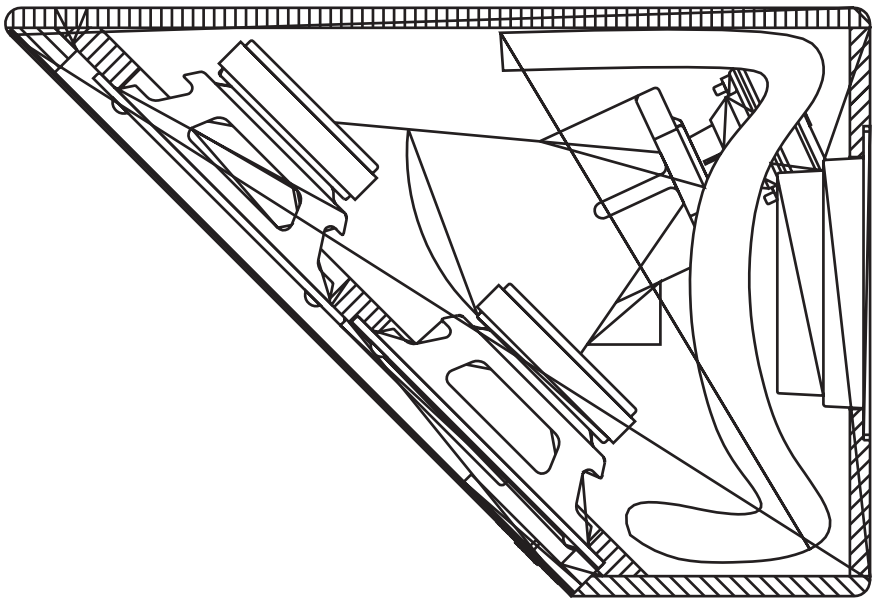
Electro-Voice®

EVI-28



250-Watt Two-Way Compact Vari Intense® Speaker System

- **Ground-breaking advance in single-box utility**
- **New small-format Vari Intense® horn for consistant SPL throughout the room**
- **DH2010A titanium compression driver**
- **Dual 8-inch high-power woofers with amplitude, frequency and delay shading**
- **1400-watt peak, 250-watt long-term power capacity**
- **Secure terminal strip inputs**
- **Compact, lightweight, refinishable, easy-to-install enclosure with U-bracket option**

Description

The Electro-Voice EVI-28 full-range loudspeaker is a 250-watt, two-way, high-efficiency system featuring a new small-format Vari Intense® horn and dual 210 mm (8-inch) direct radiators in a compact vented enclosure. The EVI-28 combines patented-Vari Intense® technology with amplitude-, frequency- and delay-shading techniques in a fully passive system to a package that is an industry first in performance, size and cost-effectiveness.

The EVI-28 is intended to be used as a stand-alone full-range system, but may also be used as the midbass/high-frequency component in most multi-way loudspeaker systems. The primary applications for the EVI-28 are in smaller rooms, rooms with lower ceilings than applicable for the EVI-12 and EVI-15, and as a complementary system for upper balconies and under-balcony areas. The system is optimized for regular throws on sloped floorplans of approximately 10 to 15 degrees or long throws on a flat floorplan relative to the mounting height.

The high-frequency section of the EVI-28 utilizes a new small-format Vari Intense® horn driven by the DH2010A one-inch throat, wide-bandwidth, titanium-diaphragm compression driver. This driver uses a unique, convex-drive Time Path™ phasing plug structure (U.S. Patent #4,525,604). The voice coil is coupled to the diaphragm with EV's exclusive Resonant Drive™ technology. This increases and smooths the high-frequency response and reduces the amount of internal equalization for flat frequency response past 25,000 Hz.

EV's self-resetting PRO™ circuit is built into the crossover network to guard the compression driver from damage. If input power to the driver exceeds the nominal rating, the pro circuit is activated, reducing the power delivered to the driver by 6 dB. The system will remain in this mode of operation until input power is reduced to a safe level.

The optimally vented bass section of the EVI-28 is designed using Thiele-Small parameters for efficient performance to below 60 Hz. The dual proprietary 210-mm (8-inch) high power, long excursion low frequency drivers deliver outstanding performance. The woofers feature a low-mass extended 51-mm (2-inch) diameter voice coil combined with a large magnet structure, a stiff, high-internal-damping cone and high-temperature materials for years of reliable performance.

The EVI-28 full-range Vari Intense® loudspeaker system is the ideal system whenever high output full frequency range material must be reproduced for balconies, cinemas, distributed systems and smaller rooms in churches, gymnasiums, auditoriums, hotels and civic centers.

Frequency Response

The combination of dual 210 mm (8-inch) woofers, a wide-bandwidth high-frequency driver and an equalized, delay-, frequency- and amplitude-shading crossover results in the wide and smooth overall response shown in Figure 1. The EVI-28's long-throw axial frequency response was measured in Electro-Voice's large anechoic chamber at a distance of 10 feet with a swept sine-wave input of 4 volts. Figure 1 has been averaged and corrected for 1 watt/1 meter.

Directivity

The polar response of the EVI-28 speaker system at selected one-third-octave bandwidths is shown in Figure 2. These polar

1. The use of Vari Intense® horns is protected by U.S. patent #5,020,630.

responses were measured in an anechoic environment at 20 feet using one-third-octave pink-noise inputs at 2 degree resolution (over 870,000 data points). The frequencies selected are fully representative of the polar response of the system. Beamwidth of the system utilizing the complete one-third-octave polar data is shown in Figures 5 and 6. R_θ and the directivity index (D_i) are plotted in Figure 7.

Constant Directivity and Variable Intensity

Constant-directivity systems are specially tuned to provide a consistent, smooth transition from the low-frequency subsystem through the high-frequency horn's operating range. These systems nearly always have symmetrical vertical dispersion patterns and a constant horizontal dispersion versus elevation. When a constant-directivity system is installed above a surface, the SPL on the floor varies significantly from front-to-back and left-to-right. The front-to-back variation can be minimized by tilting the horn further back, but this always results in a large amount of slap echo, less dynamic range and poor intelligibility as a result of excessive energy dispersed into the reverberant field. The solution is Electro-Voice's revolutionary patented[1] Vari Intense® horn that throws a 6- to 10-dB hotter signal to the back of the room while providing a wide nearfield angle and a narrow farfield angle. The variable horizontal angle ensures a rectangular floor pattern, and the intensity change compensates for the drop in SPL over the longer distance to the back of the room (13 feet for the short throw and 55 feet for the long throw in a typical underbalcony application such as Figure 7). This single horn replaces a short-throw/long-throw horn combination, cutting materials and labor time while increasing performance with higher intelligibility and more uniform coverage. The system is provided with a 2,000-Hz passive crossover featuring tweeter protection and a proprietary passive equalization circuit that provides frequency-shading, amplitude-shading and time delay to the two woofers. An Acoustic Lens Filter (ALF) on the grille helps to eliminate spurious lobes and provides a degree of acoustic loading. These features heavily modify the polar response of the two woofers, providing an extremely uniform polar pattern with a shape that matches the VI horn's unique SPL profile. They also smooth the transition between woofers and the horn to minimize horizontal lobes, providing amazingly even coverage through the crossover point. This extends the VI characteristic down to 500 Hz in an extremely compact enclosure.

Installation Tactics

The EVI-28 is designed to provide substantially even SPL over a floorplan of a size that is determined by the height of the system above the floor and the vertical aiming angle of the system relative to the floor. The recommended operational vertical angle is minus 5 degrees from the top surface of the enclosure to minus 45 degrees, defining a maximum used vertical dispersion of 40 degrees. The standard aiming of the system when it is mounted above a flat floor is with the top of the enclosure parallel to the floor. In this orientation, the system will provide even SPL over a floorplan that is approximately twice as wide as the mounting height, and five times as long. Tilting the enclosure down by approximately 10- to 15-degrees relative to the slope of the floor will produce a floorplan twice as wide as the mounting height and approximately three times the depth. At the standard aiming, the 45-degree nearfield operational angle defines an approximate offset to the first useable row of one-half the height of the speaker system above the listening plane.

In a typical installation, the top surface of the loudspeaker will point slightly above the head height of the furthest targeted seating or standing area. This will ensure the minimum amount of slap echo from the back wall. In an under-balcony situation, the sharp cutoff above the zero degree axis prevents early ceiling reflections from causing interference patterns in the listening area. Since the EVI-28 has a very smooth and rapid drop-off towards directly below the cabinet, you can actually stand right in front of the speaker (see Figure 10) without ear strain or microphone feedback. The remarkable absence of lobes to the rear allows the system to be mounted directly overhead to target a particular area without disturbing the audience below or behind the cabinet.

For example, Figure 9 shows a typical under-balcony application that has a floor with an upward slope of 5 degrees. The speaker is mounted 10 feet above the seated head height, so the horizontal width is fixed at approximately 20 feet. The enclosure is tilted back by 5 degrees to provide a 50-foot throw, with the outskirts of the pattern filling in the rear aisle area with tonally accurate but reduced overall SPL. If the under-balcony seating area is only 35 feet deep, then the enclosure should be tilted down by about 10 degrees relative to the floor in order to prevent excess slap echo and preserve intelligibility.

Figure 10 shows a typical small-room application, perfect for a 20-foot by 30-foot boardroom or meeting hall. In this case, the head height is actually defined by a standing height of approximately 6 feet, so the long-throw axis should be very close to vertical. Then the included 40 degree angle points directly towards the entire listening area, minimizing slap echo while retaining a full width, high intelligibility and even SPL throughout the listening area.

Power Handling

To our knowledge, Electro-Voice was the first U.S. manufacturer to develop and publish a power test closely related to real-life conditions. First, we use a random-noise input signal because it contains many frequencies simultaneously, just like real voice or instrument program. Second, our signal contains more energy at extremely high and low frequencies than typical actual program, adding an extra measure of reliability. Third, the test signal includes not only the overall "long-term average" or "continuous" level - which our ears interpret as loudness - but also short-duration peaks which are many times higher than the average, just like actual program. The long-

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term average level stresses the speaker thermally (heat). The instantaneous peaks test mechanical reliability (cone and diaphragm excursion). The sine-wave test signals sometimes used have a much less demanding peak value relative to their average level, providing a much higher power handling specification than is appropriate for real-world use. In actual use, long-term average levels exist from several seconds on up, but we apply the long-term average for eight hours, adding another measure of reliability. Additional extremely high-stress tests developed in-house push components to the limits to ensure long-term reliability under the most extreme cases of abuse.

Specifically, the EVI-28 is designed to withstand the power test described in ANSI/EIA RS-426-A 1980. The EIA test spectrum is applied for eight hours. To obtain the spectrum, the output of a white-noise generator (white noise is a particular type of random noise with equal energy per bandwidth in Hz) is fed to a shaping filter with 6-dB-per-octave slopes below 40 Hz and above 318 Hz. When measured with the usual constant-percentage bandwidth analyzer (one-third-octave), this shaping filter produces a spectrum whose 3-dB-down points are at 100 Hz and 1,200 Hz with a 3-dB-per-octave slope above 1,200 Hz. This shaped signal is sent to the power amplifier with the continuous power set at 250 watts into the 6.9-ohm EIA equivalent impedance. Amplifier clipping sets instantaneous peaks at 6 dB above the continuous power, or 1000 watts peak. The EVI-28 has been thoroughly tested at an AES equivalent power level of 350 watts continuous for 2 hours with 1,400 watt peaks. This procedure provides a rigorous test of both thermal and mechanical failure modes.

Amplifier Power Recommendations

As noted in the Power-Handling Capacity section above, the EVI-28 has a random-noise power capacity of 250-watts long term (1000-watts peak) per ANSI/EIA RS-426-A 1980. The following guidelines will help relate this number to an appropriate power amplifier output rating.

1. To use the EVI-28 to full capacity, skilled experts in sound-system installation and operation will obtain the best results if the power amplifier is 2.0 to 4.0 times the long-term average noise power rating of the speaker system. For the EVI-28, this is 500 to 1000 watts.

The caution cannot be made strongly enough, however, that this arrangement is only for experts or for those who can discipline themselves against "pushing" the system for ever-higher sound levels and who can avoid "accidents" such as catastrophic feedback or dropped microphones.

2. A more conservative, "normal" amplifier size, which will produce audible results nearly equal to those of the "expert" recommendation, is 1.0 to 1.4 times the long-term average noise power rating of the speaker. For the EVI-28, this is 250 to 350 watts.
3. To be very conservative, one can use an amplifier rated at 0.5 to 0.7 times the long-term average noise power rating of the loudspeaker. For the EVI-28, this is 125 to 175 watts.

Request P.A. Bible Addition No. Two ("Power Handling Capacity") for more background on these recommendations.

EVI-28 Connections

Electrical connections to the system are made by large screw terminals able to accept up to 10-gauge wire, mounted to an input panel on the back of the enclosure.

Speaker Protection

The EVI-28 like all other vented systems experiences rapidly increasing cone excursion below the box tuning frequency, while the acoustic output decreases rapidly. To ensure a long woofer life even when used at high power levels, it is recommended that some form of electronics be used to control unnecessary woofer cone excursion.

Graphic equalizers and active crossovers are two methods that can be used to prevent low-frequency signal below bandpass from going to the loudspeaker. When using and active crossover, a high-pass filter with a cut-off frequency of 35- to 50-Hz will provide the necessary protection. The filter should have a slope of at least 12 dB per octave. Such subpass band filters are found in many crossovers and equalizers manufactured by Electro-Voice, as well as other commercially available equipment.

Enclosure Construction and Refinishing

The enclosure is constructed from high-grade void-free 12-mm (0.5-inch) 9-ply and 18-mm (0.71-inch) thick 13-ply birch plywood and lined with sound-absorbent cotton batting. This high-strength enclosure is coated with an attractive textured black or white finish for a truly professional appearance. Systems with unfinished enclosures suitable for staining come with a black grille and may be ordered for a small additional charge. The included 3/8-16 hanging points ensure easy installation in nearly every application. The grille is constructed from a sturdy 16-gauge medium-gloss black or white powder-coated steel and may be painted or covered with cloth to match the enclosure. If the grille is painted, the acoustic foam insert should be removed during painting and reattached with a contact or spray adhesive on the grille, such as 3M Super 77. Take extreme care to replace the foam insert in its original position and prevent paint or adhesive from covering the foam, as it will obstruct the pores and degrade the performance of the system.

Suspending EVI-28 Enclosures

WARNING: Suspending any object is potentially dangerous and should only be attempted by individuals who have a thorough knowledge of the techniques and regulations of rigging objects overhead. Electro-Voice strongly recommends that the EVI-28 be suspended taking into account all current national, federal, state and local regulations. It is the installer's responsibility to ensure that the speaker system has been safely installed in accordance with all such regulations. Electro-Voice strongly recommends that all sus-

pended items be inspected at least once a year and any weakened or damaged parts be replaced immediately.

The recommended mounting method is the optional U-Bracket hanging kit, EVI-28MB, available in black or white. It attaches to the 3/8" t-nut locations on each side of the enclosure, allowing the system to be hung individually or in an array. A set of mounting holes for an OmniMount 100 are included on each EVI-28MB bracket. Electro-Voice recommends a minimum safety factor of 8:1, or greater if local codes or regulations exceed this amount. The EVI-28MB brackets exceed this safety factor when installed in compliance with Electro-Voice recommendations.

Architect's and Engineer's Specifications

The loudspeaker system shall be of the full-range type consisting of dual 210-mm (8-inch) high-efficiency, extended-voice-coil, high-power woofers in a vented enclosure and a 25.4 mm (1-inch) exit compression driver loaded with a small-format Vari Intense® horn. The loudspeaker system shall employ a passive crossover that provides amplitude, frequency and delay shading to the 8-inch woofers and provide high-frequency protection for the compression driver. The loudspeaker system shall meet the following performance criteria. Power handling shall be 250 watts of pink noise with an 6-dB crest factor for eight hours, or 350 watts of pink noise with an 6-dB crest factor for two hours, band-limited from 62 Hz to 25 kHz. Frequency response shall be smooth and uniformly usable from 62 Hz to 25 kHz. Pressure sensitivity shall be 93.0 dB SPL when measured at one meter on axis with one watt of band-limited pink noise from 62 Hz to 25 kHz. The enclosure shall be constructed of 12-mm (0.5-inch) 9-ply and 18-mm (0.71-inch) 13-ply birch plywood and shall be braced and lined with sound-absorbent glass wool. The finish of the enclosure shall be textured black or white and a removable black or white metal grille shall be provided. The dimensions of the enclosure shall be 353 mm (13.9 inches) high by 496 mm (19.5 inches) wide by 523 mm (20.6 inches) deep. The loudspeaker system shall weigh 13 kg (35 lb).

The loudspeaker system shall be the Electro-Voice EVI-28.

Uniform Limited Warranty

Electro-Voice products are guaranteed against malfunction due to defects in materials or workmanship for a specified period, as noted in the individual product-line statement(s) below, or in the individual product data sheet or owner's manual, beginning with the date of original purchase. If such malfunction occurs during the specified period, the product will be repaired or replaced (at our option) without charge. The product will be returned to the customer prepaid. **Exclusions and Limitations:** The Limited Warranty does not apply to: (a) exterior finish or appearance; (b) certain specific items described in the individual product-line statement(s) below, or in the individual product data sheet or owner's manual; (c) malfunction resulting from use or operation of the product other than as specified in the product data sheet or owner's manual; (d) malfunction resulting from misuse or abuse of the product; or (e) malfunction occurring at any time after repairs have been made to the product by anyone other than Electro-Voice or any of its authorized service representatives. **Obtaining Warranty Service:** To obtain warranty service, a customer must deliver the product, prepaid, to Electro-Voice or any of its authorized service representatives together with proof of purchase of the product in the form of a bill of sale or receipted invoice. A list of authorized service representatives is available from Electro-Voice at 600 Cecil Street, Buchanan, MI 49107 (616/695-6831 or 800/234-6831). **Incidental and Consequential Damages Excluded:** Product repair or replacement and return to the customer are the only remedies provided to the customer. Electro-Voice shall not be liable for any incidental or consequential damages including, without limitation, injury to persons or property or loss of use. Some states do not allow the exclusion or limitation of incidental or consequential damages so the above limitation or exclusion may not apply to you. **Other Rights:** This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Electro-Voice Speakers and Speaker Systems are guaranteed against malfunction due to defects in materials or workmanship for a period of five (5) years from the date of original purchase. The Limited Warranty does not apply to burned voice coils or malfunctions such as cone and/or coil damage resulting from improperly designed enclosures. Electro-Voice active electronics associated with the speaker systems are guaranteed for three (3) years from the date of original purchase. Additional details are included in the Uniform Limited Warranty statement.

Service and repair address for this product: Electro-Voice, Inc., 600 Cecil Street, Buchanan, Michigan 49107 (616/695-6831 or 800/234-6831).

Electro-Voice operates under a policy of continuous improvement, therefore specifications subject to change without notice.

Figure 1 — EVI-28 Long-Throw Frequency Response (4 volts/10 feet normalized to 1 watt/ 1 meter, anechoic environment)

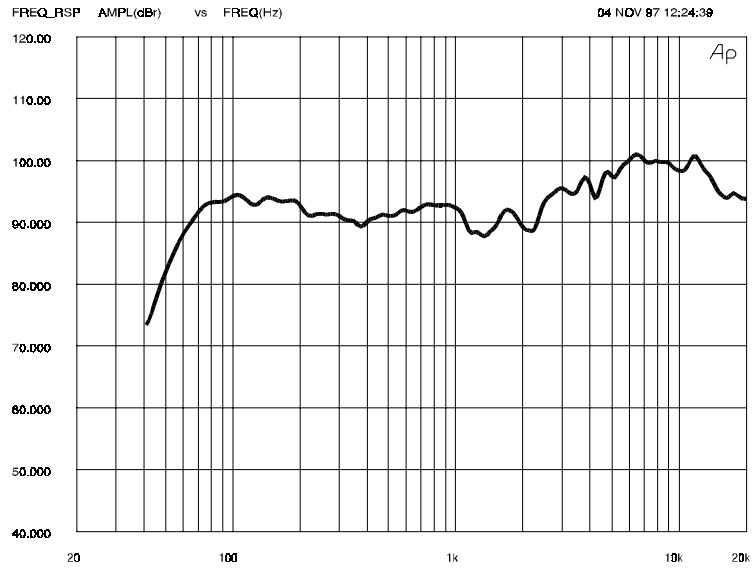


Figure 2 — Polar Response

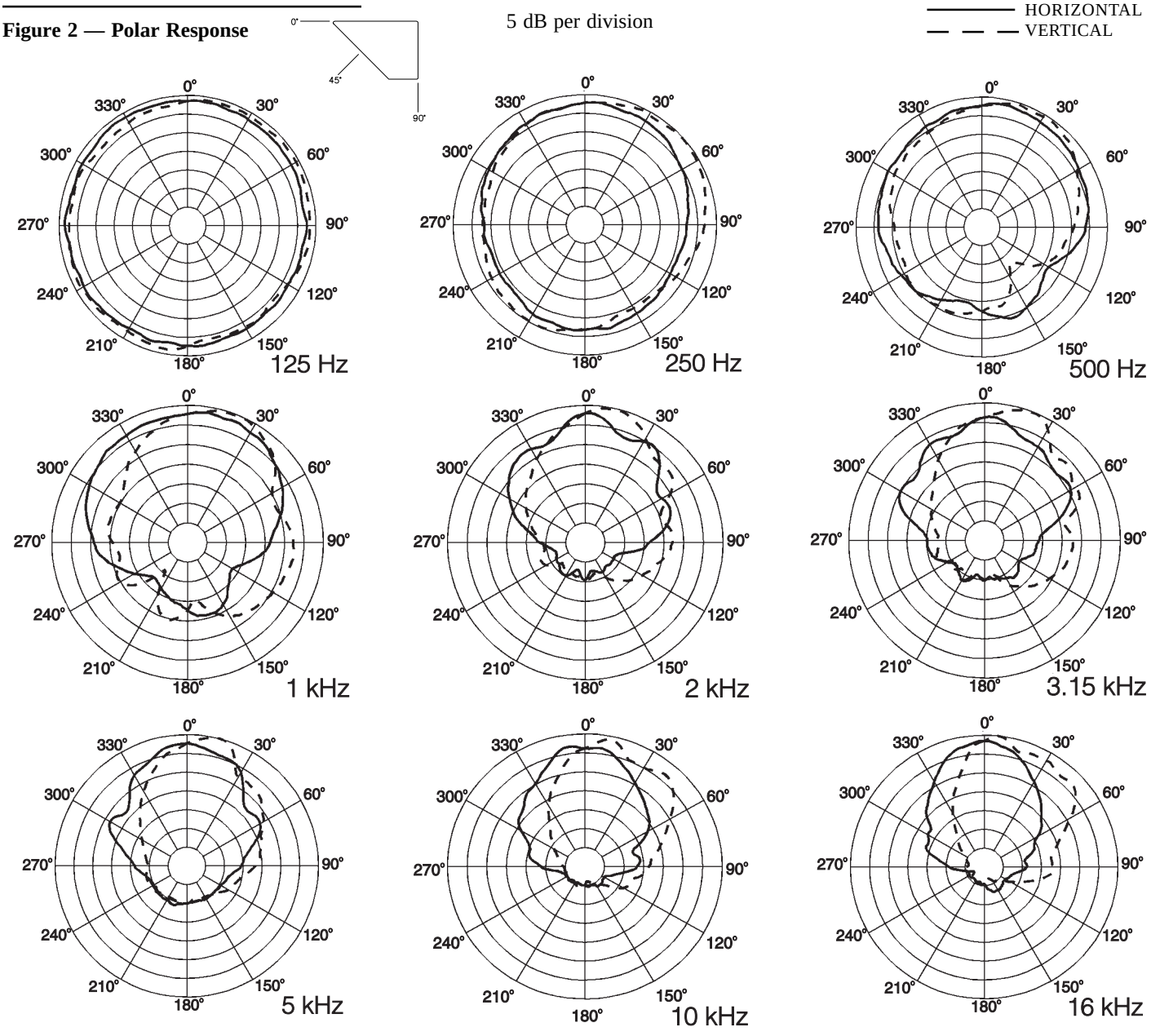


Figure 3 — EVI-28 Impedance

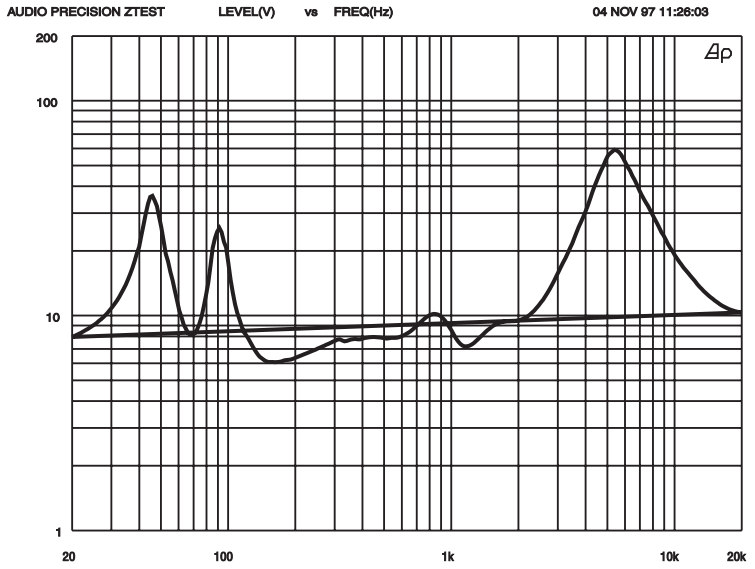


Figure 4 — EVI-28 Distortion at 0.1 Rated Power, 25W (anechoic environment)

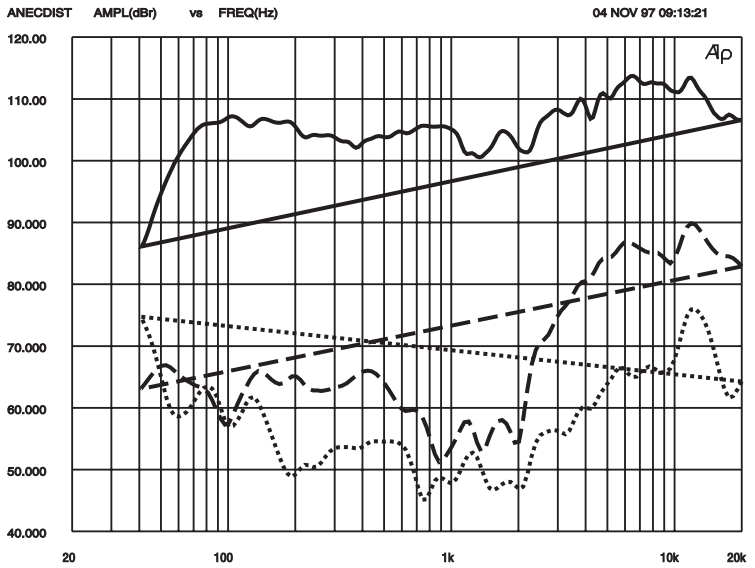


Figure 5 — EVI-28 Short-Throw Horizontal Beamwidth vs. Frequency (anechoic environment @ 20ft)

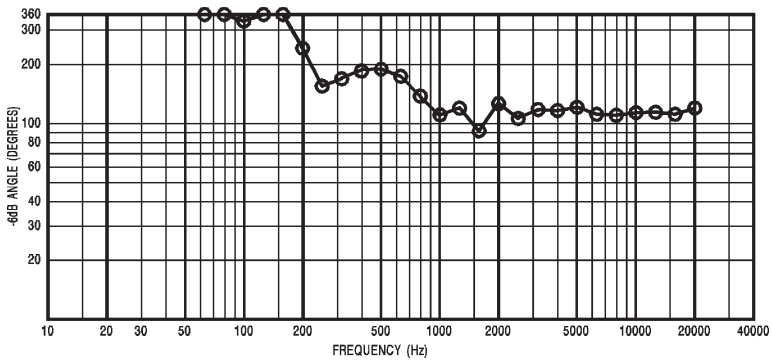


Figure 6 — EVI-28 Long-Throw Horizontal and Vertical Beamwidth vs. Frequency (anechoic environment @ 20ft)

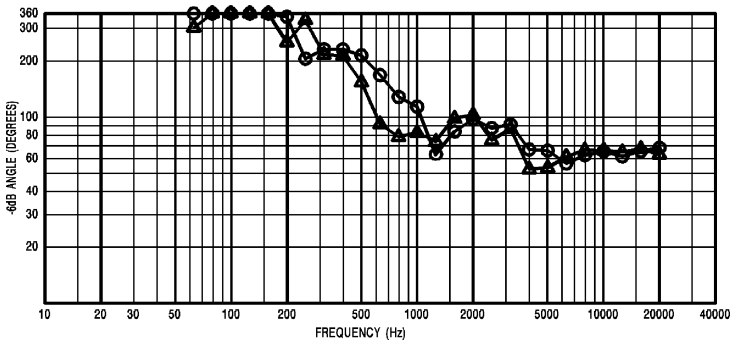


Figure 7 — EVI-28 Directivity vs. Frequency (anechoic environment @ 20ft)

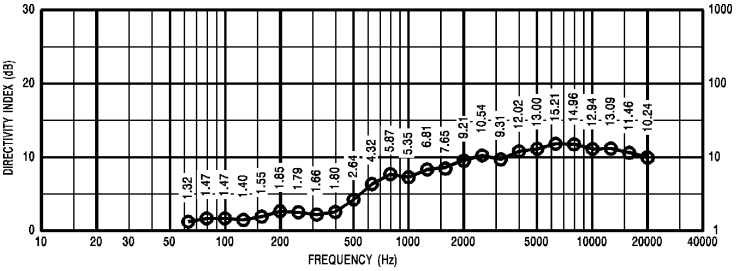


Figure 8 — EVI-28 Dimensions

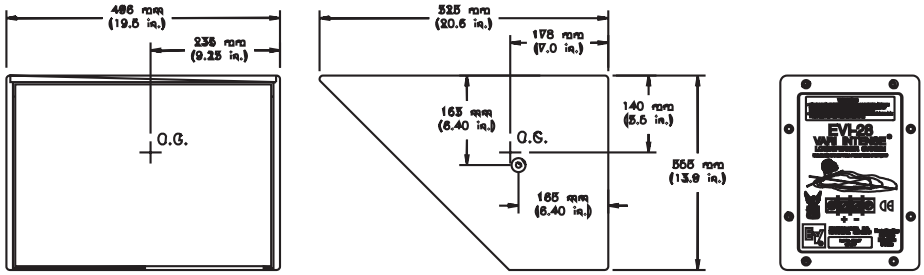


Figure 9 — Balcony Installation

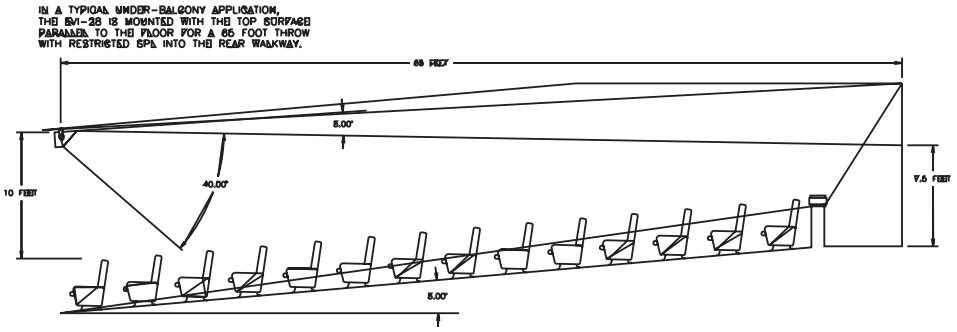
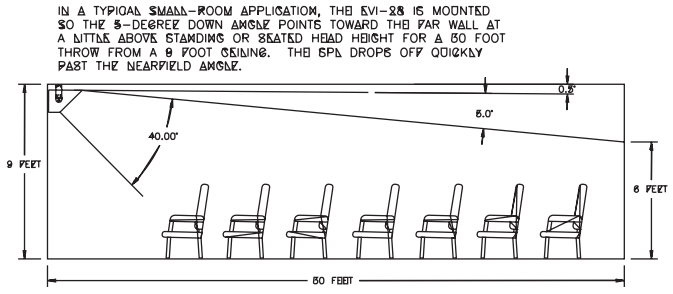


Figure 10 — Small-Room Installation



Specifications

Axial Frequency Response, Swept Sine Wave, 4 volts at 3.05 meters (10 feet), anechoic environment, normalized for 1 watt at 1 meter; see Figure 1:
62-25,000Hz

Low-Frequency 3-dB-Down Point:
62 Hz

Usable Low-Frequency Limit (10-dB-Down Point):
50 Hz

Half-Space Reference Efficiency:
1.1%

Power Handling Capacity (see Power-Handling Capacity Section):
250 watts, long-term continuous (8-hour)
350 watts, short-term continuous (2-hour)
1400 watts, peak power

Maximum Woofer Acoustic Output:
3.8 watts

Sensitivity (SPL at 1 watt, 1 meter input, anechoic environment, swept sine wave, 62-25,000Hz):
93 dB

Maximum Output (SPL at rated power, including any power compression due to nonlinearities in the system):
116 dB SPL, long-term continuous
117.5 dB SPL, short-term continuous
123.5 dB SPL, short-term peak

Dispersion Angle Included by 6-dB-Down Points on Polar Responses, Indicated One-Third-Octave Bands of Pink Noise (see Figures 5 and 6):

800-20,000 Hz, Short-Throw Horizontal:
110 degrees +/-20 degrees

1,000-20,000 Hz, Long-Throw Horizontal:
65 degrees +/-20 degrees

600-20,000 Hz, Vertical:
65 degrees +/-20 degrees

Directivity Factor, R_θ(Q) 1,600 - 20,000 Hz average (see Figure 7):
11.7 (+3.5,-3.8)

Recommended Operational Vertical Angle (see Figure 4):
-5 degrees to -45 degrees

Distortion, 0.1 Full Power Input (see Figure 4), Second Harmonic,

100 Hz:
-49 dB, 0.35%

1000 Hz:
-51 dB, 0.3%

10,000 Hz:
-27 dB, 4.5%

Third Harmonic,

100 Hz:
-50 dB, 0.3%

1000 Hz:
-58 dB, 0.1%

10,000 Hz:
-44 dB, 0.6%

Transducer Complement,

Low Frequency:
Dual 8-inch high-efficiency, high-power woofers

High Frequency:
DH2010A driver

Box-Tuning Frequency:
67 Hz

Crossover Specifications, Full-range,

Crossover Frequency:
2,000 Hz

Crossover Slope,

Low Pass:
12 dB per octave with frequency, delay and amplitude shading

High Pass:
12 dB per octave

Impedance (see Figure 3):

Nominal:
8 ohms

Minimum:
6.2 ohms (225 Hz)

Input Connections:
Large shielded screw terminals for up to 10 gauge wire

Driver Protection, High Frequency:
Solid-state self-resetting circuit (PRO™ circuit) drops output 6 dB

Enclosure:
Direct-radiating vented LF, built of 12 mm (0.5-inch) 9-ply and 18 mm (0.71-inch) 13-ply birch plywood with appropriate bracing, lined with flame-retardant cotton batting

Enclosure Colors:
Black or white with black or white pow der-coated perforated-metal grille

Dimensions (see Figure 8):

Height:
353 mm (13.9 inch)

Width:
496 mm (19.5 inch)

Depth:
523 mm (20.6 inch)

Net Weight:
16.3 kg (36 lb)

Shipping Weight:
21.8 kg (48 lb)

Accessories:
Electro-Voice EVI-28MB-BK black U-Bracket suspension kit
Electro-Voice EVI-28MB-WH white U-Bracket suspension kit

Attachment Points:
Two 3/8”-16 hanging points included

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